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STUDY SUPERVISION: ITS NEED IN THE MATHEMATICS OF THE ELEMENTARY AND SECONDARY SCHOOLS.

By A. M. Curtis.

The remarks of the last speaker in emphasizing the importance given by Harvard to ability of the student to accomplish in limited time definite tasks are most timely in view of the point I wish to bring to your attention under the title on your program.

The school work of the seventh and succeeding years has been so planned in many schools that study under the restraints of the school-room has been given over to the pupil's own free methods on his own time.

The results of this unorganized work are brought to the teacher at the recitation period and are inspected by her, if in written form, or tested by question in oral exercise. Such lessons are prepared by the pupils on any sort of paper and by any methods they happen to devise, whether good or bad. The main object being to copy up in immaculate form a finished product acceptable, first, to the teacher's zealous eye for form and, second, for a "passing" number of correct "answers."

Such work is pernicious. It leaves the vital element in the training, which mathematics ought and, if properly taught, does give, entirely to a haphazard, makeshift chance.

Such copied work gives little insight into a pupil's real ability in work habit and power. It never can tell the teacher how many trials were necessary in solving a problem; how much time was wasted by aimless manoeuvring; nor whether a bungling, crude, roundabout method of computation was employed where a brief reflection and mental calculation would and ought to find application. In fact this copied home work reveals but little. The work the teacher should see is to be found in the home waste basket, on rough paper, perhaps slovenly in appearance, and wrongly computed. This point is so important I illustrate it by the following comparisons:

Problem: At $3½ per head, what will 17 sheep cost?

Papers (copied work) give, perhaps uniformly the following statement:

17 × $3½ = $59½, cost, Ans.

If, however, the teacher were to see the original work, differences would appear somewhat as follows:

Pupil A—17 × 7/2 = 119/2 = 59½.

Pupil B—

$$\begin{array}{r} 3.5 \\ \underline{17} \\ 245 \\ \underline{35} \\ 59.5 \end{array}$$

Pupil C—

$$\begin{array}{r} 17 \\ \underline{3\tfrac{1}{2}} \\ 8\tfrac{1}{2} \\ \underline{51} \\ 59\tfrac{1}{2} \end{array}$$

Pupil D—17 × 3½ = 51 + 8½ = 59½.

Which of the pupils has the best practical solution? The others need but a word and they may be brought to see the value of mental power in saving work.

Problem: At 2½c each, how many yards can I buy with $6.50?

Different solutions follow:

A solves this way, producing error thereby:

$$\begin{array}{l} .025\ )\ 6.5\ (\ 26. \\ \underline{5\,0} \\ 1\,50 \\ \underline{1\,50} \end{array}$$

B solves this way:

$$\begin{array}{r} 2\,60. \\ \odot 025.\ )\ 6\odot 500. \\ \underline{5\quad 0} \\ 1\quad 50 \\ \underline{1\quad 50} \end{array}$$

C thinks: $1 buys 40 yd.

($6 buys 240 yd.
Writes....($.50 buys 20 yd.
($6.50 buys 260 yd.

C soon learns to write nothing but the result, all work being done mentally.

All the *copied* work for these pupils is the same.

A $\$6.50 \div \$.02\frac{1}{2} = 26$, therefore 26 yd. Cause of error not apparent.
B $\$6.50 \div \$.02\frac{1}{2} = 260$, therefore 260 yd.
C $\$6.50 \div \$.02\frac{1}{2} = 260$, therefore 260 yd.

Is not C's work, as *originally* thought out, in good form? Compare B's original form with A's.

I have dealt for sixteen years with high school graduates who attempt to study arithmetic methods. Of all those I have met not over twenty-five per cent. show any knowledge or habit of thought better than A or B in the illustrations above. Many can not divide by 8 in short division without placing the carrying figure on the paper.

This very experience with pupils in our school made me realize that nobody had *ever watched the working methods and habits* of these pupils.

How accomplish this watchful, helpful work in our schools?

There is but one answer. Supervise the study. And I suggest that a recitation period used frequently as a study period where the pupil works under careful restriction with definite aim as to first-time accuracy, first-time neatness, and speed, will accomplish much better results than hours of harum scarum work at home.

As to the details of such a plan, I have found the following helpful. When the study period arrives, clear the desks of all paper but one sheet and the problems. Have the work done *in ink* (no pencils in service). It is evident that this simple means forces thought before action; for a wrong attack is shown by the non-erasable ink. Neatness and long process methods are not compatible. Nor is the use of pencil in extended work conducive to the rapidity necessary for finishing the task within the allotted time.

This plan permits and suggests many a valuable exercise; for example, thinking a problem through "in the rough" to arrive at an approximate result. The teacher can give so many minutes for these first results; have them written in *ink* on the paper for the lesson, then have the remaining time given to *accurate* solution, which proves the "guess" result either close or "wild."

Such supervision is not for arithmetic alone. Nothing will put better training into algebra than this same first-time accuracy and neatness. Carelessness in sign changes, in exponent arrangement, and in the habit of verification will all be revealed to the one whose business it is to insist on the opposite traits; namely the teacher.

In geometry what more necessary exercise can be used than careful study on the following plan?

With the book-demonstrated proposition, have the pupils cover all but the theorem. Read the theorem, give hypothesis, conclusion, and construct his figure in harmony with his analysis. Now remove the cover from the figure and compare. Note the lines of construction in the text figure and speculate on their significance. Suggest lines of proof. Next study the author's proof.

Such careful teaching and habit of study give results worth while and independent pupils, book or no book. But supervision is the essential of the scheme.

To summarize this talk:

Supervision of study on the simple lines described will gain for the pupil a habit (1) of thought before action, (2) of neatness (and consequently conciseness) in form, (3) of accuracy under stress of time limit. In short, the study of mathematics *will stand for increase in power,* such as our good Harvard friend mentioned but now.

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